

TEST EFFECTIVENESS TREND OBSERVATION

Test Effectiveness and Reliability Growth in JPL Programs

CONCLUSION:

JPL flight programs show an increase in test effectiveness and reliability growth with the onset of the Viking Orbiter (over the last 20 years).

DISCUSSION:

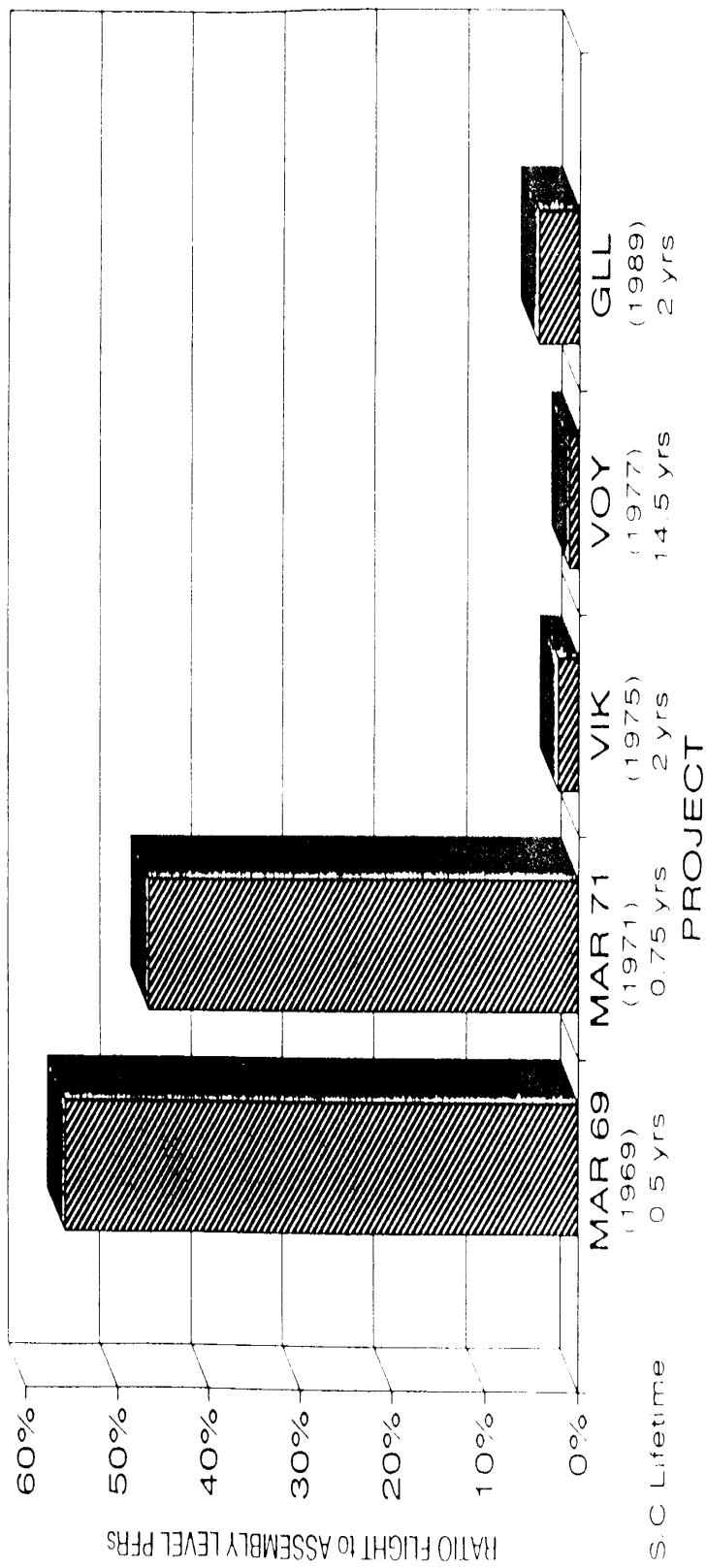
The attached figure is a plot of the ratio of inflight problems/failures (P/Fs), normalized by spacecraft years, to the number of P/Fs, normalized by the number of hardware sets undergoing environmental testing in each flight program noted in the Figure, generated during assembly-level environmental testing.

Two concepts are illustrated here. One is the effectiveness of the environmental test program as demonstrated by the number of P/Fs detected after launch to those detected prior to launch. The best measure of test effectiveness is the capability of the test program to uncover potential spacecraft failures prior to launch.

The second concept is the ability of the spacecraft designers to take advantage of past spacecraft flaws to improve design, select less vulnerable parts and materials, and develop manufacturing and workmanship processes less prone to failure (i.e. reliability growth).

The five flight programs considered and plotted in chronological order in the figure show a marked decrease in the ratio of in-flight P/Fs to test P/Fs, starting with the Viking Orbiter. This figure illustrates the success achieved through improving test effectiveness or producing more reliable spacecraft hardware with maturity. It should be noted that the spacecraft flight history of Galileo is presently only two years, so the correlation to Viking and Voyager could change.

Effectiveness of Test Program and Reliability Growth as a Function Time



- Flight Anomalies normalized by S/C years
- Test Anomalies normalized by no. of hardware sets undergoing hardware testing